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TITLE OF INVENTION
SYSTEM AND METHOD FOR MANAGING OPERATING SYSTEMS

APPLICANT(S) FOR DO/EO/US

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Applicants herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
 2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
 3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
 4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
 5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
 6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
 7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
 8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
 9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
 10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).
- Items 11. to 16. below concern other document(s) or information included:
11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
 12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
 13. ☐ A **FIRST** preliminary amendment.

☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
 14. ☐ A substitute specification and marked-up specification.
 15. ☐ A change of power of attorney and/or address letter.
 16. ☒ Other items or information: International Search Report, PCT Request Form, published PCT application WO 01/20456

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17. <input checked="" type="checkbox"/> The following fees are submitted:			<u>CALCULATIONS</u> <u>PTO USE ONLY</u>	
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO \$860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) \$690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$710.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$1,000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$100.00				
ENTER APPROPRIATE BASIC FEE AMOUNT =			\$ 860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).			\$ 0.00	
Claims **	Number Filed	Number Extra	Rate	
Total Claims	10 - 20 =	0	X \$18.00	\$ 0.00
Independent Claims	2 - 3 =	0	X \$80.00	\$ 0.00
Multiple dependent claim(s) (if applicable)**			+ \$270.00	\$ 0.00
TOTAL OF ABOVE CALCULATIONS =			\$860.00	
Reduction by 1/2 for filing by small entity, if applicable.			\$860.00	
** Following entry of Preliminary Amendment			SUBTOTAL =	\$860.00
Processing fee of \$130.00 for furnishing the English translation later the <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).			+	\$
TOTAL NATIONAL FEE =			\$860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property			+	\$
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NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) Deposit Account No. or (b)) must be filed and granted to restore the application to pending status.				
SEND ALL CORRESPONDENCE TO:				
Kenyon & Kenyon One Broadway New York, New York 10004 (212) 425-7200 - Telephone (212) 425-5288 - Facsimile		<u>Edward W. Greason</u> SIGNATURE		
		Edward W. Greason, Reg. No. 18,918 NAME		
		<u>Aug 30 2001</u> DATE		

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PATENT TRADEMARK OFFICE

SPECIFICATION

SYSTEM AND METHOD FOR MANAGING OPERATING SYSTEMS

5 TECHNICAL FIELD

The present invention relates to a system for managing information item of a plurality of operating systems. More particularly, the present invention relates to a system for managing and editing/displaying trace log information of a plurality of operating systems (hereafter, to be abbreviated as OS in some cases).

BACKGROUND ART

In the case of a system for executing processes under the control of a plurality of different operating systems in accordance with a real time processing, a general information processing, an interchanging processing between old and new items, and other processes, the user will wish to manage the operations of those operating systems consistently.

This is why conventional operating system management systems, when managing trace log information items, have enabled each of those operating systems to execute a trace log editing/displaying program and have trace log information in itself. And, as disclosed in the official

gazette of Unexamined Published Japanese Application
No.9-134300, when editing error log information items
collected by a plurality of operating systems installed in
a plurality of host computers, those conventional systems
5 have used a well-known method, which sorts and merges such
error log information items sequentially in order of times
at which they are generated.

However, each operating system makes time management
by its own way and usually calculates an elapsed time with
10 use of a timer interruption, etc., thereby updating the time
managed by itself. Consequently, such the time managing
method has been divided clearly into two types; the times
of all the operating systems are adjusted to the time of any
one of those operating systems as disclosed in the official
15 gazette of Unexamined Published Japanese Application
No.6-332568 and/or No.5-307424 or the times of all those m
the time of a reference operating system.

However, the time management method differs among
types of operating systems. If a plurality of operating
20 systems are running in a computer, therefore, the
interruption processing method and the processing timing
will also differ among those operating systems. And
accordingly, the times managed by those operating systems
do not agree to each another. Consequently, event trace log
25 information items collected by those operating systems

cannot be merged in order of times at which they are
generated through an arithmetic operation performed by an
operator or a computer as disclosed in the above
conventional technology. This is because the times of
5 managed by those operating systems are different from each
another.

Under the circumstances, it is an object of the
present invention to provide an operating system management
system for enabling each operating system to manage its time
10 by itself and managing a sequence of events generated among
those operating systems accurately.

DISCLOSURE OF THE INVENTION

In order to achieve the above object, the operating
system management system of the present invention manages
15 the correspondence among the times managed by a plurality
of operating systems running in one computer. Consequently,
traces, which become check points, are recorded in the trace
information of those operating systems so that those check
20 points are regarded to have been generated approximately at
the same time. In addition, the operating system management
system of the present invention adds a counter value to the
trace information of each of those operating systems as
additional information and manages the correspondence among

the times managed by those operating systems running in one computer.

The operating system management system is provided with means for editing/displaying a trace information sequence of events in order they are generated and recorded by those operating systems in order their events are generated according to the correspondence among the traces to be assumed as check points, added counter values, or times managed by those operating systems. When displaying event data items related to a plurality of operating systems, the management system adjusts the sequence for displaying events according to the correspondence among those events in those operating systems so as to adjust the sequence of the times of those events.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is an overall block diagram of a trace log management system of the present invention.

Fig.2 is a hardware block diagram of the trace log management system of the present invention.

Fig.3 is a schematic flowchart of the operation of the trace log management system of the present invention.

Fig.4 is a model case for an operating system switching trace employed as a check point trace.

Fig.5 shows how traces are displayed in the first embodiment of the present invention.

Fig.6 shows a model case for a variation of the first embodiment.

5 Fig.7 shows a model case for another variation of the first embodiment.

Fig.8 is a block diagram of the trace log editing/displaying system in the second embodiment of the present invention.

10 Fig.9 is another block diagram of the trace log editing/displaying system in the second embodiment of the present invention.

15 Fig.10 shows a computer for operating a trace log editing/displaying program in another embodiment of the trace log management system of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

20 Hereunder, a description will be made in detail for the embodiments of an operating system management method of the present invention with reference to the accompanying drawings. The operating system management method is employed for a trace log editing/displaying system used to trace and display events of a plurality of operating systems.

The trace log editing/displaying system in the first embodiment of the present invention is applied to a trace result to be assumed as a check point (to be referred to as a check point trace), which is an event logs corresponded to those of other operating systems as an operation information item used as a time reference of operation information items regarded to have been generated approximately at the same time among those operating systems. Fig.1 shows a schematic block diagram of a trace log editing/displaying system of the present invention. In one computer 101 are installed the first operating system 310 (to be abbreviated as OS1) and the second operating system 320 (to be abbreviated as OS2). A control program 201 manages the operation states of a plurality of operating systems (OS1 and OS2). In this embodiment, it is premised that the OS1 and the OS2 are replaced alternately and operated in a time sharing manner. The OS1 has time information 312 managed by itself and operation trace information 311 representing the operation history thereof based on this time information 312. In the same way, the OS2 has time information 322 managed by itself and operation trace information 321. What is notable here is that the times 312 and 322 managed by OS1 and OS2 do not always agree to each other. In this embodiment, a trace log editing/displaying program 401 is operating under the

control of the OS1. The program 401 edits and displays operation trace information items collected by operating systems. The program 401 can also run under the control of the OS2.

5 The control program 201 enables each operating system to store a check point trace in both operation trace information 311 of the OS1 and operation trace information 321 of the OS2 (801, 802). This check point trace is a trace of an event corresponded to each operating system. The check point trace is an operation information item generated
10 commonly in both OS1 and OS2 and used as a time difference among those operating systems. Consequently, it is only required for a recorded check point trace that at least it is corresponded to each operating system. It is not required
15 necessarily that it is recorded completely in the same way in the log of each operating system. The trace log editing/displaying program 401 reads the operation trace information 311 recorded in the OS1 and the operation trace information 321 recorded in the OS2 (803, 804). The trace
20 log editing/displaying program 401 searches a check point trace from two operation trace information items 311 and 321. If the object check point trace is found, the program 104 finds the correspondence of the trace among the check point traces of other operating systems. Then, even when
25 the times of the check point traces recorded by operating

systems differ from each other, the trace log editing/displaying program 401 regards that the traces are generated actually at the same time, thereby editing traces included in two operation trace information items (805) and displaying the result on the display unit 102 (806).

Fig.2 is a hardware block diagram of a computer system for realizing the trace log editing/displaying system of the present invention. In this computer 101, a computing unit 104 is connected to a system bus via an address converter 107. The system bus 101 is connected to a main memory 103, an interruption device 108, a timer 109, and a video adapter 111. The video adapter 111 is connected to a display unit 102. The main memory 103 is shared by a plurality of operating systems (OS1 and OS2). The main memory 103 is roughly divided into a common area 103-1 used commonly by those operating systems, an OS1 area 103-2, and an OS2 area 103-3. The common area 103-1 stores a control program 201. The OS1 area 103-2 is a memory area used to operate the OS1. The OS1 area 103-2 stores the OS1 program 310 itself, OS1 managed time information 312, and OS1 operation trace information 311. In the same way, the OS2 area 103-3 stores the OS2 program 320 itself, OS2 managed time information 322, and OS2 operation trace information 321. And, two address registers (105 and 106) are provided and used to store the address of each area provided in the main memory.

The address register 105 specifies the common area 103-1 and the address register 106 is selected by the control program 201 and it specifies an area of the present running operating system. In Fig.2, the address register 106 specifies the OS1 area 103-2. This means that the OS1 is executed by the control program 201.

Fig.3 shows a schematic flowchart of the operation of the trace log editing/displaying system of the present invention. At first, check point traces are stored in the OS1 operation trace information and the OS2 operation trace information beforehand (801 and 802). To display the operation trace information of both OS1 and OS2 in order they are generated, the trace log editing/displaying program reads both OS1 operation trace information and OS2 operation trace information (803 and 804). Searching the OS1 operation trace information and the OS2 operation trace information, the trace log editing/displaying program finds check point traces that are regarded to have been generated simultaneously in operating systems OS1 and OS2 from their trace information items. This trace information item is decided as a reference time of other times regarded approximately the same time in both OS1 and OS2, then both OS1 and OS2 trace information items are merged in order they are generated (step 805). The merged trace information

items of both OS1 and OS2 are then displayed on the display unit (step 806).

Next, a description will be made in detail for an embodiment of the control program 201 with reference to Figs.4 and 5. The embodiment uses an OS switching trace as a check point trace. Fig.4 shows a model case for a series of generated traces. In Fig.4, the time axis is taken in the vertical direction. Actual OS1 operation states are shown at the left side and actual OS2 operation states are shown at the right side. In this embodiment, the OS1 and the OS2 run in one computer in a time sharing manner. It is premised here that the control program 201 changes operating systems. Thus, the OS1 and the OS2 never run simultaneously. A trace name Ax(x: 1 to 4) is given to each trace of the OS1 and a trace name Bx(x: 1 to 4) is given to each trace of the OS2. SWz(z: 1 to 3) is given to each trace in which an operating system is switched to another, that is, a record that the state of an operating system is changed from "run" to "standby" or vice versa. This trace is common to both OS1 and OS2.

At first, A1 (501-1) was generated and traced at an OS1 managed time of 10:00:00. Then, A2 (501-2) was generated and traced at 10:00:01 and A3 (501-3) was traced at 10:00:03, both times were managed by the OS1. After that, an OS switching event was generated (503-1) at an OS1 managed time

of 10:00:05 in response to the command from the control program 201 and SW1 (501-4) was recorded in an OS1 trace, thereby the present operating system OS1 was changed to OS2. At this time, the OS2 managed time was 10:00:35. This means
5 that the OS1 managed time and the OS2 managed time are different by 30 sec from each other. The OS2 thus recorded SW1 (502-1) as a trace according to the command for restarting the operation from the control program 201. The OS2 then started its operation and recorded traces of B1
10 (502-2) at the OS2 managed time 10:00:36 and B2 at 10:00:37 respectively. Then, the operating system OS2 was changed to OS1 (503-2) at an OS1 managed time of 10:00:40. The OS1 managed time at that time was 10:00:10. Just like in the above case, the SW2 traces (502-4, 501-5) were recorded in
15 both OS1 and OS2 at that time. Hereafter, the events A4(501-6), SW3(501-7, 502-5), B3(502-6), and B4(502-7) were generated as described above and their traces were recorded.

Those trace results are stored in both OS1 and OS2 operation trace information items (311 and 321) in order of
20 times managed by those operating systems. It is premised here that each trace is stored so as to be corresponded to its given name. The trace name may be a trace code managed by the corresponding operating system or the control program 201. Consequently, A1 to A4 and SW1 to SW3 (501-1 to 501-7)
25 are stored in the OS1 trace information in order they are

generated in the OS1 together with OS1 managed times. In the same way, B1 to B4 and SW1 to SW3(502-1 to 502-7) are stored in the OS2 trace information 321 in order they are generated in the OS2 together with OS2 managed times.

5 The trace log editing/displaying program 401 searches an SWz(z: 1 to 3) used as a check point trace from both OS1 and OS2 operation trace information items (311 and 321). Then, if there is at least one trace between SWz and SWz+1, it is decided that an operating system having the operation
10 trace information is running during the time in which SWz and SWz+1 are recorded. If there is no trace found between SWz and SWz+1, it is decided that another operating system is running or the original operating system is running. In this embodiment, because B1 and B2 traces are found in the
15 OS2 operation trace information between SW1 and SW2, it is decided that the OS2 is running. And, an A4 trace is found between SW2 and SW3, it is decided that the OS1 is running. If it is considered that the OS1 and the OS2 are switched sequentially, it is decided that the OS1 is running before
20 SW1 and the OS2 is running in and after SW3.

 If check point traces are to be corresponded to each other, generated check point traces are common to both OS1 and OS2. Thus, the same number of check point traces come to be included in each of OS1 and OS2 operation trace
25 information items at equal time intervals regardless of

their managed time values. Consequently, event names or codes stored in each operation trace information are checked for agreement, as well as traces of common events assumed as check points are searched sequentially starting at the first one, thereby finding the traces that agree to each other.

Fig.5 shows results of trace data edited and displayed by the trace log editing/displaying program in order they are generated actually according to the operation trace information 311 of the IS1 and the operation trace information 312 of the OS2. In Fig.5, OS switching traces SW_z (z=1 to 3), which are check point traces (SW1, SW2, and SW3), are displayed in a thick line frame respectively. Those OS switching traces may also be displayed in different colors. For example, SW_z may be displayed in red and other traces may be displayed in black.

Next, a variation of the first embodiment of the present invention will be described with reference to Fig.6. In this embodiment, a synchronization trace is employed instead of an OS switching trace (check point trace) for which the control program 201 is used. The control program 201 stores a synchronization trace at the same timing as those of the OS1 operation trace information 311 and the OS2 operation trace information 321 regardless of each OS status. Consequently, even when the OS1 managed time 312

and the OS2 managed time 322 are different from each other, a timer difference between those operating systems can be known through collation of operation trace information items of both OS1 and OS2 according to this synchronization trace information. The trace generation sequence can thus be known.

Fig.6 shows a model case for a series of generated traces. In Fig.6, the time axis is taken in the vertical direction. Actual operations of the OS1 are shown at the left side and those of the OS2 are shown at the right side. In this embodiment, it is premised that OS1 and OS2 are running in one computer in a time sharing manner. Thus, OS1 and OS2 are never executed simultaneously. A trace name Ax(x: 1 to 4) is given to each OS1 trace and a trace name Bx(x: 1 to 4) is given to each OS2 trace. The trace name S1 is a synchronization trace used as a check point trace in this embodiment. The trace is common to both OS1 and OS2.

At first, the trace of A1 (504-1) is recorded at an OS1 managed time 10:00:00 and the trace of A2 (504-2) is recorded at 10:00:01. Then, the trace of a synchronization S1 (506-1) is recorded in both OS1 operation trace information and OS2 operation trace information at an OS1 managed time 10:00:02 (504-3, 505-1). At this time, the OS2 managed time was 10:00:32. Then, the trace of A3 (504-4) was recorded in OS2 at 10:00:03. After that, an OS switching

event (506-2) occurred, thus control was passed to OS2. Then, the traces of B1 (505-2) and B2(505-3) were recorded in OS2 at 10:00:36 and 10:00:37 respectively. Furthermore, an OS switching event (506-3) occurred, and the trace of A4 (504-5) was recorded in OS1. After the OS switching (506-4), the traces of B3 (505-4) and B4(505-5) were recorded in OS2 respectively. After that, A1 to A4 and S1 (504-1 to 504-5) were stored as OS1 traces in the operation trace information 311 together with the OS1 managed times in order they were generated in OS1. In the same way, B1 to B4 and S1(505-1 to 505-5) were stored as OS2 traces together with OS2 managed times in order they were generated.

The trace log editing/displaying program 401, when editing/displaying an actual sequence of generated traces according to both of the operation trace information 311 of the OS1 and the operation trace information 312 of the OS2, searches a check point synchronization trace from the operation trace information items of both OS1 and OS2. Finding the synchronization trace S1 (504-3, 505-1), the program 401 decides the S1 (504-3) stored in the OS1 operation trace information 311 as a reference point. Because the S1(504-3) was generated at an OS1 managed time of 10:00:02, the relative times at which other OS1 traces were generated is calculated with reference to this time as follows.

Relative time = trace generation time- reference
point generation time

It is thus found that A1 takes -2sec, A2 takes -1sec,
A3 takes 1sec, and A4 takes 10sec.

5 The relative times of OS2 traces are also calculated
in the same way. Because the reference point S1 (505-1) was
generated at OS2 managed time 10:00:32, B1 takes 4sec, B2
takes 5sec, B3 takes 12sec, and B4 takes 13sec. These
10 results are displayed so that the time axis is taken in the
vertical direction (from top to bottom) and OS1 traces are
shown at the left side and OS2 traces are shown at the right
side. Those traces are displayed in ascending order of
calculation results of the above relative times from top to
bottom in the format of one trace per line. Then, the
15 synchronization traces (504-3 and 505-1), which were
generated simultaneously in both OS1 and OS2, are displayed
on the same line. The synchronization traces are also
displayed in a thick line frame respectively or in different
colors. Consequently, traces of each OS are displayed
20 sequentially from top to bottom in order they are actually
generated.

Furthermore, a description will be made for another
variation of the first embodiment of the present invention
with reference to Fig.7. In this embodiment, instead of a
25 check point trace recorded by the control program 201 as

described above, an inter-OS communication trace (509-1) is used. In this embodiment, it is premised that data is transferred from OS1 to OS2. The inter-OS communication means transferring of data from the transmission program of an operating system to the receiving program of another operating system. In this case, the transmission side program records transmission traces and the receiving side program records received traces. These transmission traces and received traces are referred to as inter-OS communication traces generically. In such the inter-OS communication, transmission and receiving are corresponded to each other and both transmission program and the receiving program are executed in a synchronized manner. It is thus regarded that inter-OS communication traces recorded in both OS1 and OS2 are generated almost simultaneously. Consequently, even when the OS1 managed time and the OS2 managed time are different from each other, a time difference between those operating systems can be known through collation with the operation trace information items of both OS1 and OS2 according to this inter-OS communication trace information. This is why the sequence of generated traces can be known.

Fig.7 shows a model case for a series of generated traces. In Fig.7, the time axis is taken in the vertical direction. Actual OS1 operation states are shown at the left

side and actual OS2 operation states are shown at the right side. In this variation of the first embodiment, it is premised that both OS1 and OS2 are executed in one computer in a time sharing manner. Therefore, OS1 and OS2 are never executed simultaneously. A trace name Ax(x: 1 to 4) is given to each OS1 trace and a trace name Bx(x: 1 to 4) is given to each OS2 trace. S1 indicates a transmission trace in inter-OS communications and R1 indicates a received trace in the inter-OS communications.

At first, the trace of A1(507-1) was recorded at an OS1 managed time 10:00:00, then A2(507-2) and A3(507-3) were recorded at 10:00:01 and 10:00:03 respectively. Then, at an OS1 managed time 10:00:05, data was transmitted (509-1) from OS1 to OS2, thereby the transmitted trace S1(507-4) was recorded as an OS1 trace. At this time, a received trace R1(508-1) was recorded as an OS2 trace at the data receiving side. After that, OS switching (509-2, 509-3) was repeated, thereby traces of A4(507-5) and B1 to B4(508-2 to 508-5) were recorded in both OS1 and OS2. During this time, A1 to A4 and S1 (507-1 to 507-5) were recorded as OS1 traces together with OS1 managed times in the OS1 operation trace information in order they were generated. On the other hand, B1 to B4 and R1(508-1 to 508-5) were recorded as OS2 traces together with OS2 managed times in the OS2 operation trace information in order they were generated.

The trace log editing/displaying program 401 edits and displays actually generated traces in order they are generated according to the OS1 operation trace information 311 and the OS2 operation trace information 312.

5 Consequently, the program 401 searches a pair of inter-OS communication traces to be assumed as check points from the operation trace information items of both OS1 and OS2. In this case, if a trace S1(507-4) corresponding to a transmission event is found from the OS1 operation trace information and a trace R1(508-1) corresponding to an
10 received event from the OS2 operation trace information, then the S1(507-4) stored in the OS1 operation trace information is decided as a reference point. The S1 was generated at an OS1 managed time 10:00:05. This time is used
15 as a reference point so as to calculate the relative times of A1 to A4 as follows.

Relative time = trace generated time- reference point generated time

It is thus found that A1 takes -5sec, A2 takes -4sec,
20 A3 takes -2sec, and A4 takes 7sec. In the same way, relative times of B1 to B4 in OS2 are calculated and found as follows. The reference point is decided by regarding that a trace R1(508-1) is generated together with S1(507-4) at the same time. Because the OS2 managed time is 10:00:35 at that time,
25 B1 takes 1sec, B2 takes 2sec, B3 takes 9sec, and B4 takes

10sec. The above results are displayed so that the time axis is taken in the vertical direction (from top to bottom) and OS1 traces are shown at the left side and OS2 traces are shown at the right side. The traces are also displayed in the format of one trace per line in ascending order of calculation results of the above relative times. Since the inter-OS traces are generated simultaneously in both OS1 and OS2, they are displayed on the same line. The synchronization traces may also be displayed in a thick line frame respectively or in different colors.

Next, a description will be made for the trace log editing/displaying system in the second embodiment of the present invention with reference to Fig.8. In this embodiment, a difference between OS1 and OS2 managed times is used to edit and display trace information of both OS1 and OS2. Fig.8 is an overall block diagram of the trace log editing/displaying system in the second embodiment. In this second embodiment of the present invention, a control program 201 stores information related to a difference between OS1 and OS2 managed times as an inter-OS time difference 202.

It is premised here that the control program 201 reads the times managed by both OS1 and OS2 simultaneously and writes the time difference between OS1 and OS2 managed times in the time lag information 202. In this embodiment, it will

be found that the OS2 managed time is 10:00:30 (202-2) when the OS1 managed time is 10:00:00(202-1) and the OS2 managed time is 11:00:32 (202-4) when the OS1 managed time is 11:00:00(202-3), and the OS2 managed time is 12:00:34 (202-6) when the OS1 managed time is 12:00:01(202-1).

In this second embodiment, neither the OS1 operation trace information 311 nor the OS2 operation trace information 312 includes any check point trace. If traces are edited and displayed sequentially in order they are actually generated according to the time lag information and the operation trace information of both OS1 and OS2, the OS2 time in an OS1 time can be known from the time lag information 202. With use of this time difference as a reference point, relative times of generated traces in the operation trace information of both OS1 and OS2 are calculated as follows.

Relative time = trace generation time - reference point generation time

The relative time of each generated OS2 trace is also calculated in the same way. The calculation results are then displayed so that the time axis is taken in the vertical direction (from top to bottom) and OS1 traces are shown at the left side and OS2 traces are shown at the right side. The sequence of those traces in generation is displayed in ascending order of calculation results (from top to bottom) in the format of one trace per line. OS1 traces and OS2

traces may also be displayed in different colors for easier distinction. For example, OS1 traces may be displayed in green and OS2 traces may be displayed in red. In this second embodiment, when comparing an OS1 trace with an OS2 trace,
5 it is required that the object trace recording time band is found from the time lag information 202, then the found time band is compensated accordingly. As this time lag information, the control program 201 can read the times from both OS1 and OS2 and stores them as they are, as well as the
10 program 201 can store the time difference as a time deviation.

Next, a description will be made for the third embodiment of the trace log editing/displaying system of the present invention with reference to Fig.9. In this
15 embodiment, counter information is used to edit and display the trace information items of both OS1 and OS2. In this case, because each trace recorded in each OS is corresponded to the counter information 203 managed by the control program 201, the order of each trace is decided uniquely in
20 each of the OS1 and OS2.

Fig.9 shows an overall block diagram of the trace log editing/displaying system when counter information is used. The control program 201 has counter information 203 in itself. It is premised here that when the program P1(313)
25 in the OS1 or the program P2(323) in the OS2 records a trace,

the present counter value is read from the counter
information 203 set in the control program 201. The read
counter value is then stored in the trace information of both
OS1 and OS2 together with the trace data by the program P1
5 or P2 in the OS1 or OS2. The counter information 203 in the
control program 201 is incremented by one each time it is
read. In the operation trace information (311, 312) of both
OS1 and OS2 are recorded OS time information, trace data,
and the counter value respectively. Because the counter
10 value is incremented by one each time a trace is recorded,
a trace with a smaller value is generated earlier than a
trace with a larger value. Consequently, if operation trace
information items of both OS1 and OS2 are merged and the
counter values are sorted in ascending order, then traces
15 are listed up in order they are actually generated. Unlike
the above embodiments, it is no need to search the
correspondence among check point traces in this second
embodiment.

Next, a description will be made for the trace log
20 editing/displaying system of the present invention in
another embodiment with reference to Fig.10. In this
embodiment, it is premised that the trace log
editing/displaying program 401 is executed in another
computer. A computer system 1 operates so that a control
25 program 201 switches the operating system between OS1 (310)

and OS2 (320) installed in a computer 101. Each of the OS1
and the OS2 has operation trace information (311, 321). The
computer system 2 in which the trace log editing/displaying
program 401 is executed is hardware, which is different from
5 the computer system 1 and OS3 (330) is running in the
computer 121. The computer 121 is connected to a display
unit 102 for displaying traces. The computer 101 and the
computer 121 are connected to each other via a network 122
so as to transfer operation trace information between them.
10 Such a data storing medium as a floppy disk, etc. may also
be used as means for transferring such operation trace
information.

The trace log editing/displaying program 401
installed in the computer system 2 reads operation trace
information items 311 and 321 of both OS1 and OS2 via the
15 network 122 (803, 804), then edits traces transferred from
two operation trace information items 311 and 312 in
accordance with the same method of the first embodiment
(805) and displays the result on the display unit 102 (806).

20 Although the operation trace information items of
both OS1 and OS2 are managed by both OS1 and OS2 in the above
embodiment, it is also possible to store those operation
trace information items collectively in a common area. In
such a case, the control program 201 is provided with a
25 sub-routine program for storing traces in the operation

trace information of both OS1 and OS2 in the common area,
so that the sub-routine program is used as an interface
program executed from both OS1 and OS2. A program for
recording traces in OS1 executes this sub-routine, thereby
5 recording OS1 traces in both OS1 and OS2 operation trace
information. In the same way, a program for recording traces
in OS2 executes this program, thereby recording OS2 traces
in both OS1 and OS2 operation trace information.

Consequently, traces are recorded in both OS1 and OS2
10 operation trace information items in order they are actually
generated.

On the other hand, a program for recording traces in
OS1 and a program for recording traces in OS2 may also store
those traces directly in both OS1 and OS2 operation trace
15 information items in the common area without using such a
sub-routine.

INDUSTRIAL APPLICABILITY

As described above, the operating system management
20 system of the present invention can manage times of events
generated in a plurality of operating systems in an unified
manner while each of those operating systems has its own
managed time that is different from others and manages
traces of each of those operating systems sequentially in
25 order they are generated. Consequently, the management

system of the present invention can have an effect that error
analysis and debugging in development can be done
efficiently in a computer system in which a plurality of
operating systems are running. The system will thus be very
5 suitable for managing a computer system in which a plurality
of operating systems are running.

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CLAIMS

1. An operating system management system for managing a plurality of operating systems, comprising:

5 a recording unit for recording operation information transferred from an operation information memory for storing an operation state of each of said operating systems, said operation information being assumed as a reference to other operation information items corresponded to each another and regarded to have been generated approximately at the same time; and

10 a searching unit for searching operation information assumed as a reference to said other operation information items from said operation information items recorded in said operation information memories of said operating systems;

15 wherein said management system finds a sequence of other operation information items recorded in said operation information memories of said operating systems according to the correspondence to said searched operation information.

2. An operating system management system for managing a plurality of operating systems, comprising:

25 a recording unit for recording operation information of each operating system, transferred from a memory for

storing operation information thereof and a time at which said operation information was generated, transferred from each operating system for recording said operation information; and

5 a memory for storing time lag information among said operating systems;

 wherein said management system finds a sequence of operation information items generated and recorded in said operation information memories of said operating systems with use of said times at which said information items were generated and recorded in said operation information memories of said operating systems and said time lag information.

10 3. An operating system management system for managing a plurality of operating systems, comprising:

 an operation recording unit for recording operation information of each operating system, transferred from an operation information memory thereof;

20 wherein said operation recording unit adds a counter value to said operation information, said counter value being updated when operation information of corresponding one of said operating systems is recorded; and

 said management system finds a sequence of operation information items recorded in said first and second

25

operating systems with use of a counter value of operation information recorded in the operation information memory of corresponding one of said operating systems.

5 4. An operating system management system according to claim 1;

 wherein said operation information is at least any one of an operating system switching trace, a synchronization trace, an inter-OS communication trace.

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 5. An operating system management system for managing first and second operating systems, comprising:

 a recording unit for recording an operation information item to be assumed as a reference of times of other operation information items regarded to have been generated approximately at the same time and recorded in operation information recording memories of said first and second operating systems so as to be corresponded to each other; and

20

 a searching unit for searching an operation information item assumed as a reference to said approximately same times from operation information items recorded in said operation information memories of said first and second operating systems;

wherein said system displays said searched operation information item so as to be highlighted and disposed together with other information items in parallel and displays other operation information items in order they are generated on the basis of the correspondence to said searched operation information item.

6. A trace log management system employed for a computer system in which a plurality of operating systems are installed and each of said operating systems has operation trace information;

wherein said log management system displays both operation trace information item of an operating system and operation information items of another operating system at a timing assumed as a reference of both of said operation information items corresponded to each other and regarded to have been generated approximately at the same time.

7. An operating system management method for managing a plurality of operating systems, comprising the steps of:

enabling each of a plurality of said operating systems to record its operation information item corresponded to operation information items of other operating systems and to be assumed as a reference of operation information items

of those other operating systems, regarded to have been generated approximately at the same time;

finding the correspondence of an operation information item to be assumed as a reference of said approximately same times from operation information items recorded by said other operating systems; and

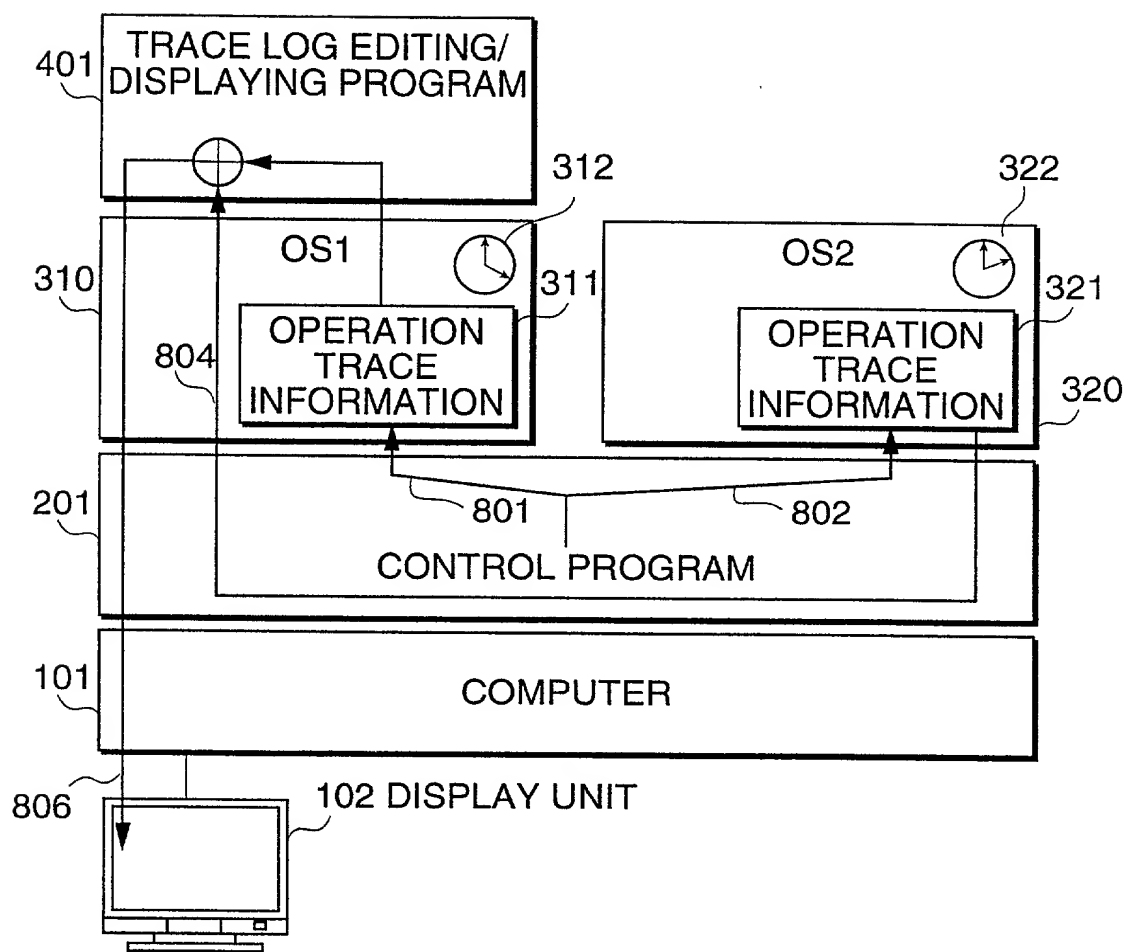
finding a sequence of operation information items recorded by said other operating systems according to said found correspondence.

8. An operating system management method for managing a plurality of operating systems, comprising the steps of:

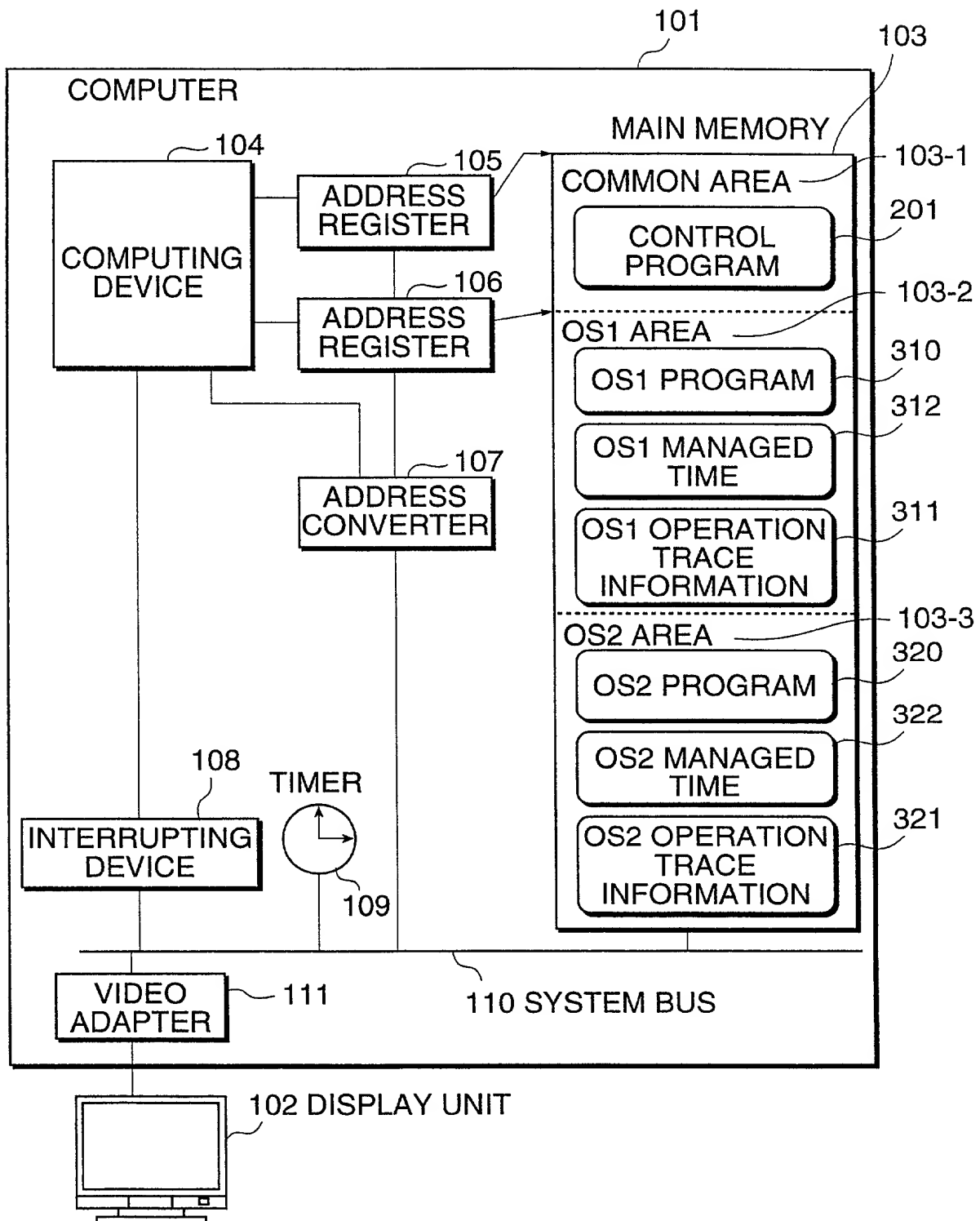
enabling each of a plurality of said operating systems to record its operation information item corresponded to operation information items of said other operating systems and to be assumed as a reference of said other operation information items regarded to have been generated approximately at the same time with reference to a counter value to be updated when an operation information item of said operating system is recorded; and

finding a sequence of recorded operation information items in order they are generated with use of a size of said counter value added to said operation information of each of a plurality of said operating systems.

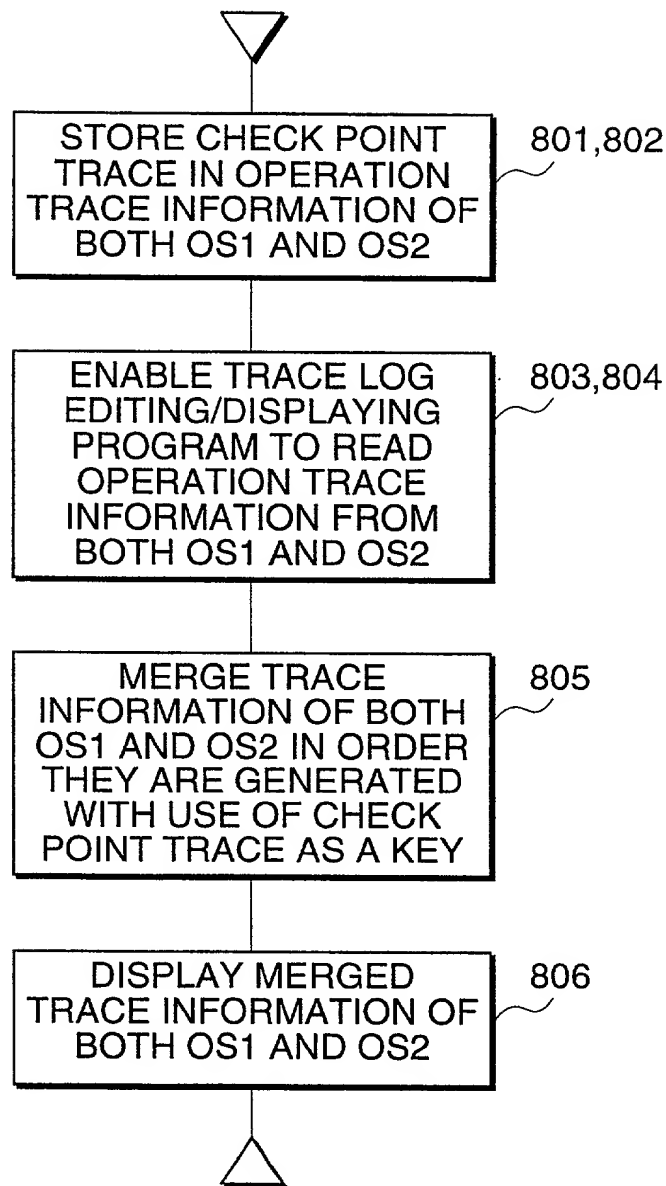
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FIG.1

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FIG.2

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FIG.3

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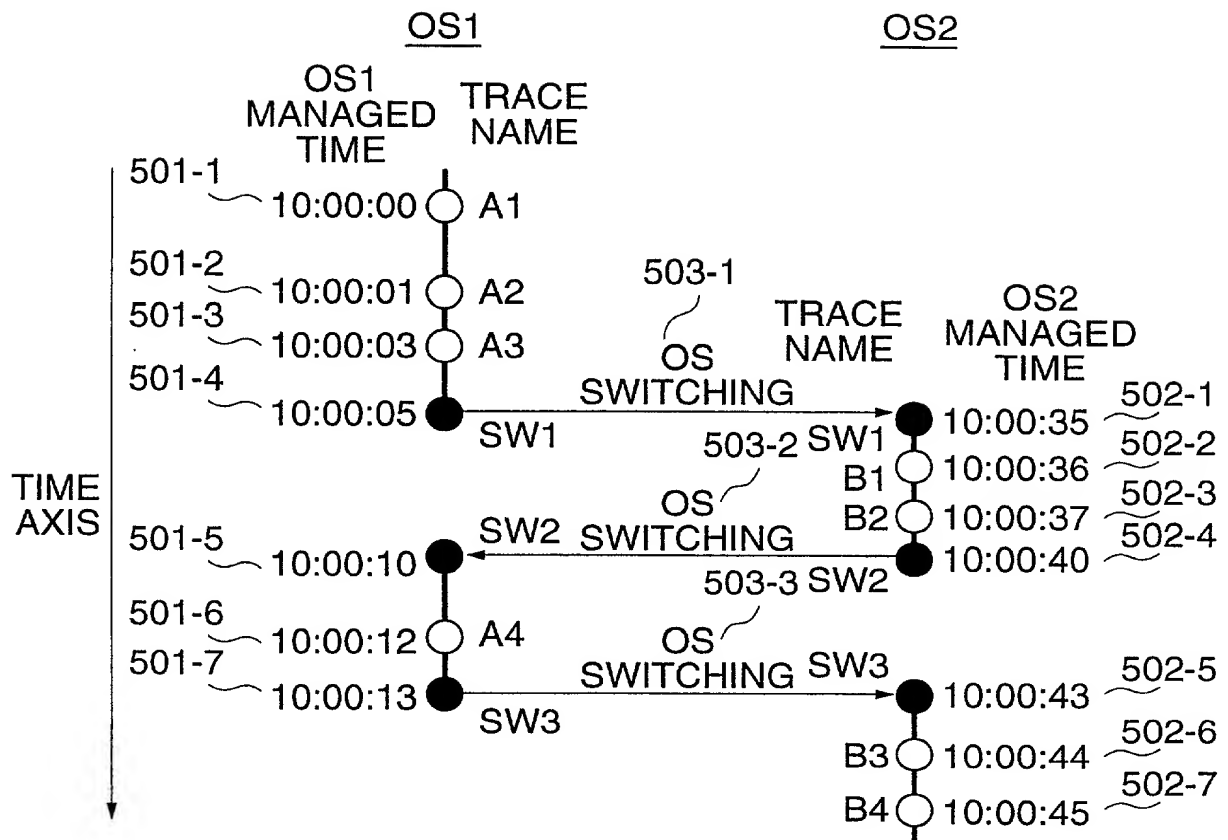
FIG.4

FIG.5

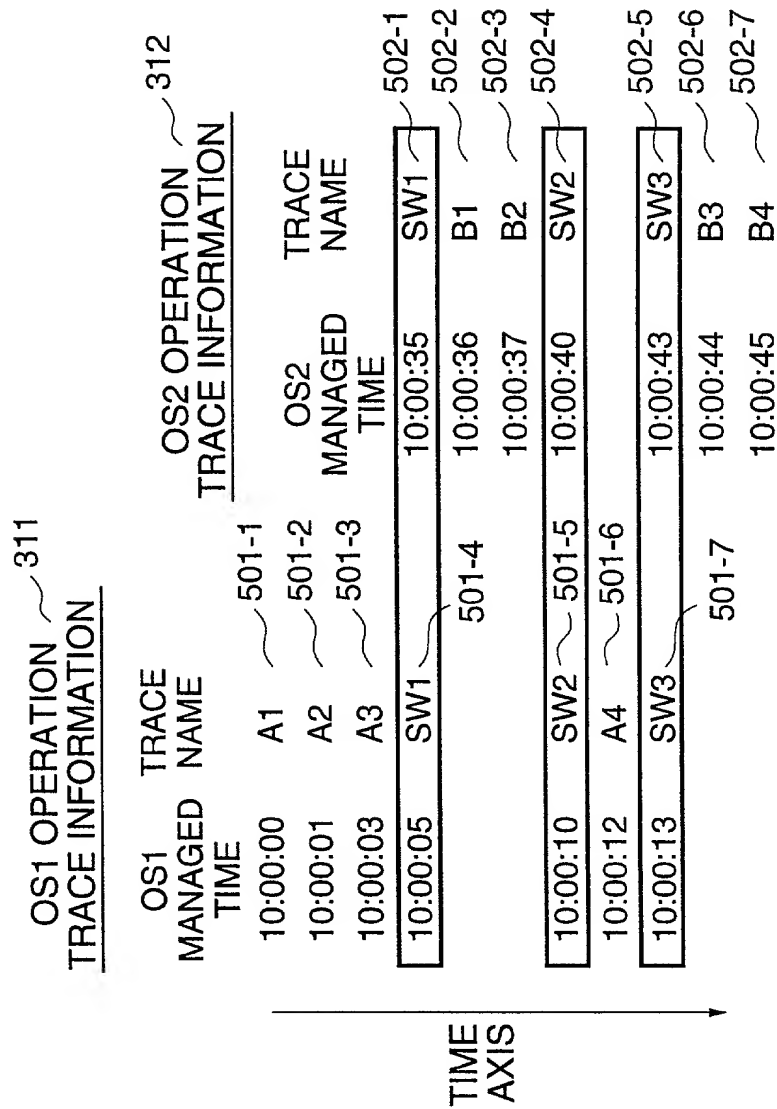


FIG. 6

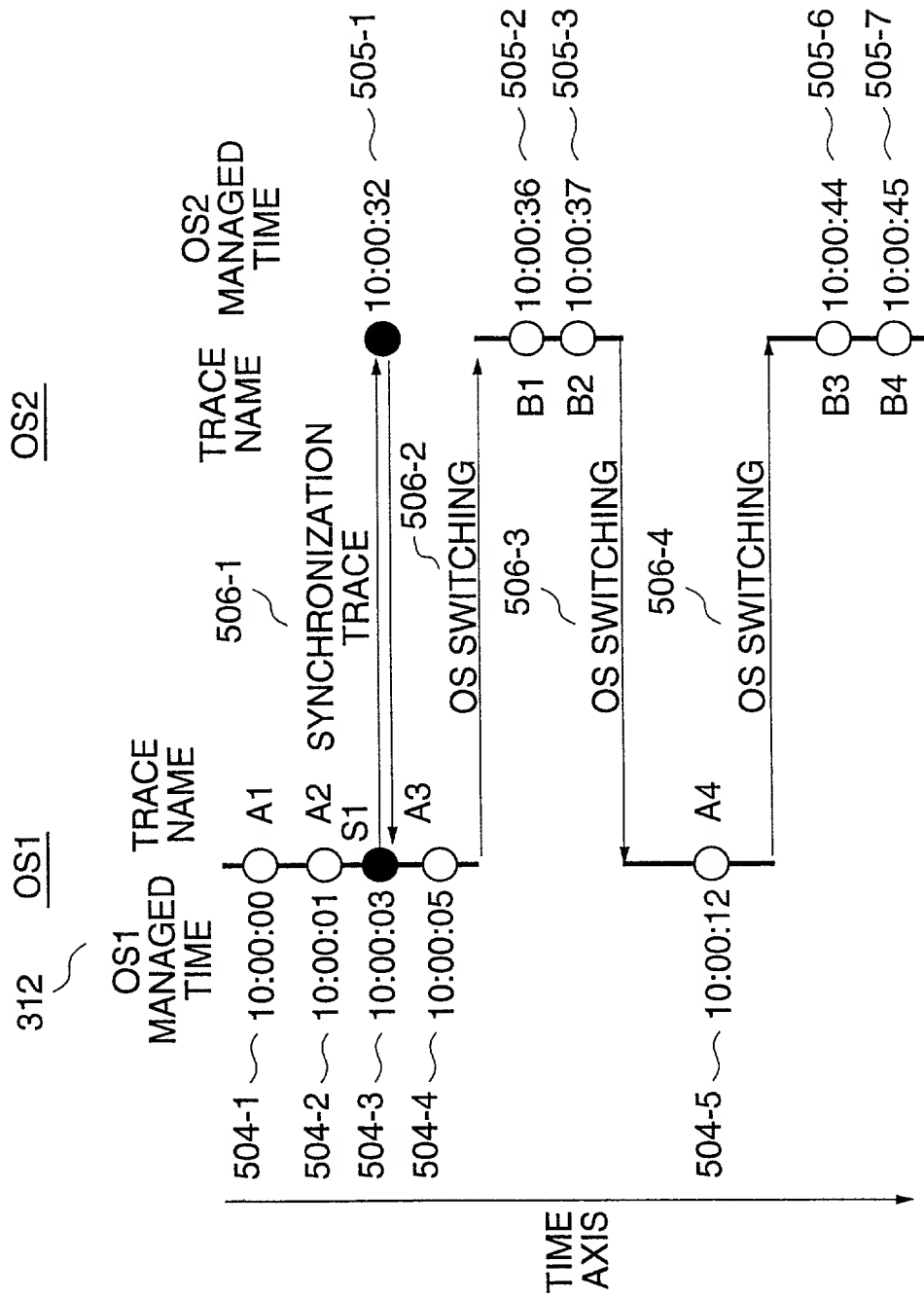
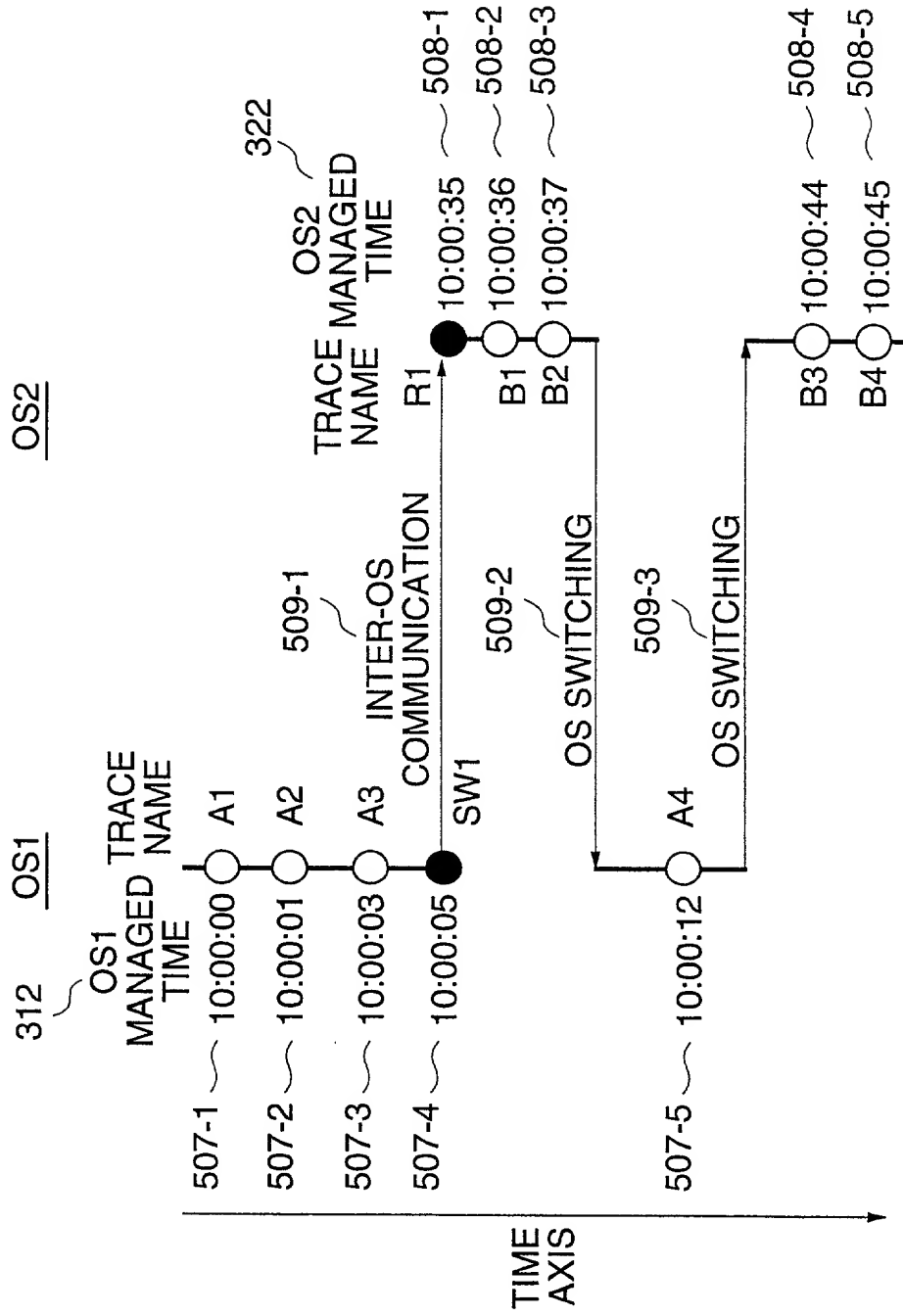


FIG. 7



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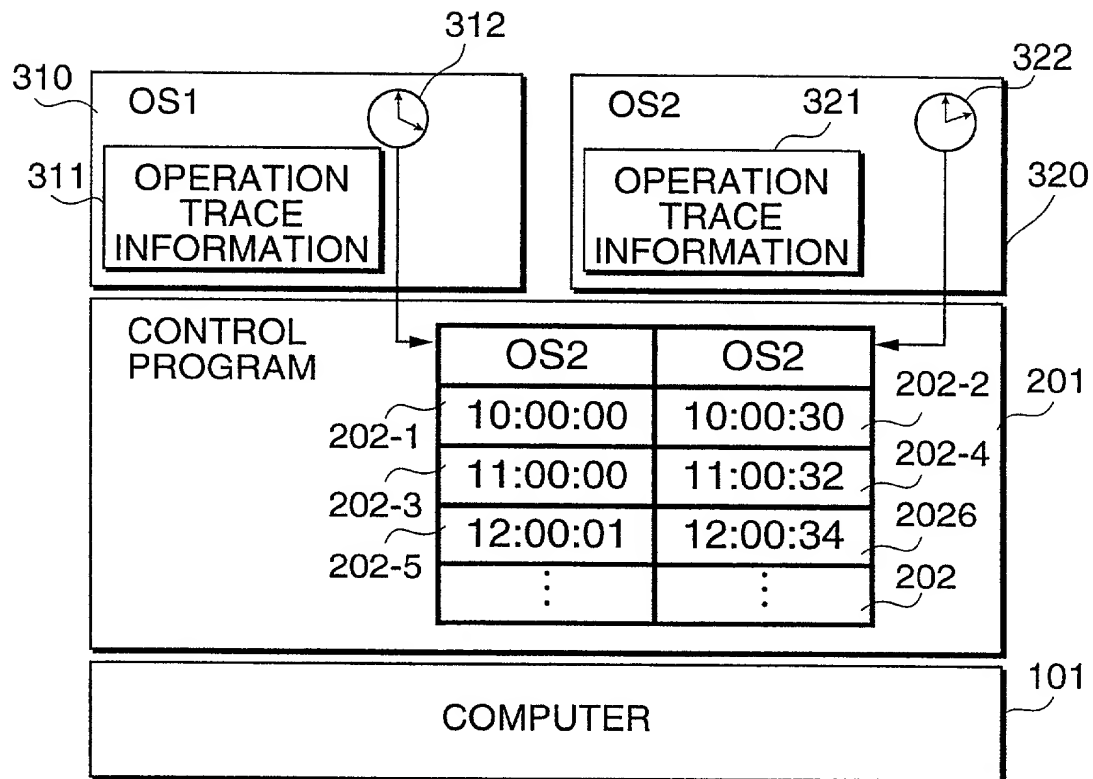
FIG.8

FIG. 9

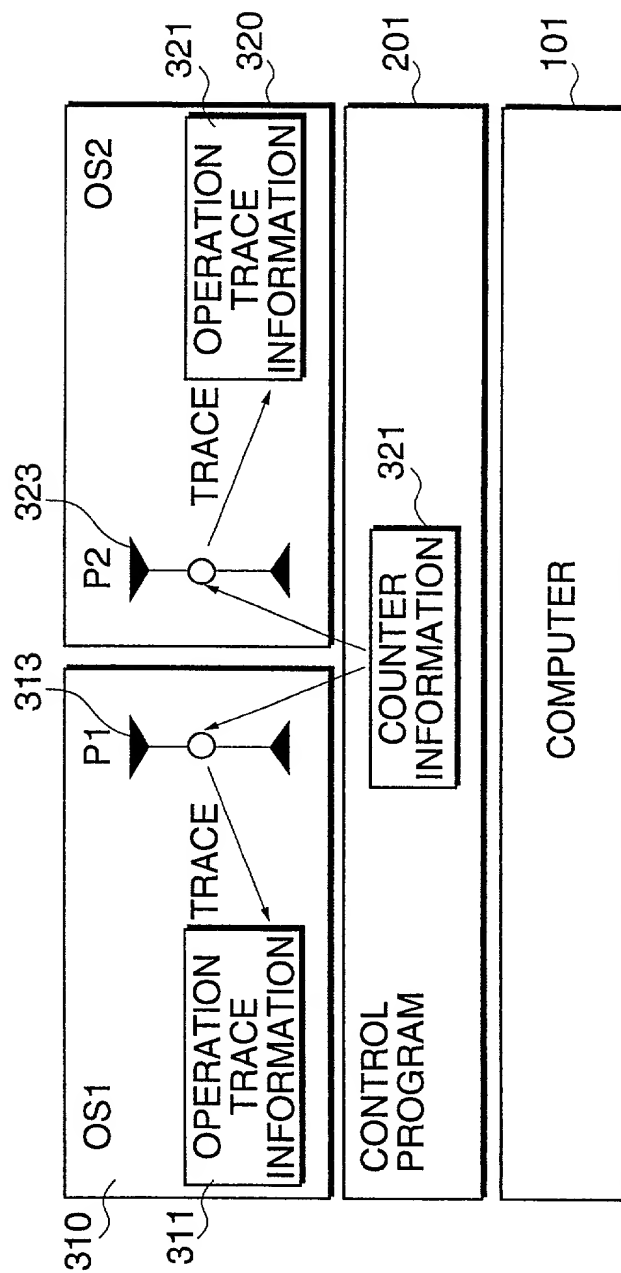
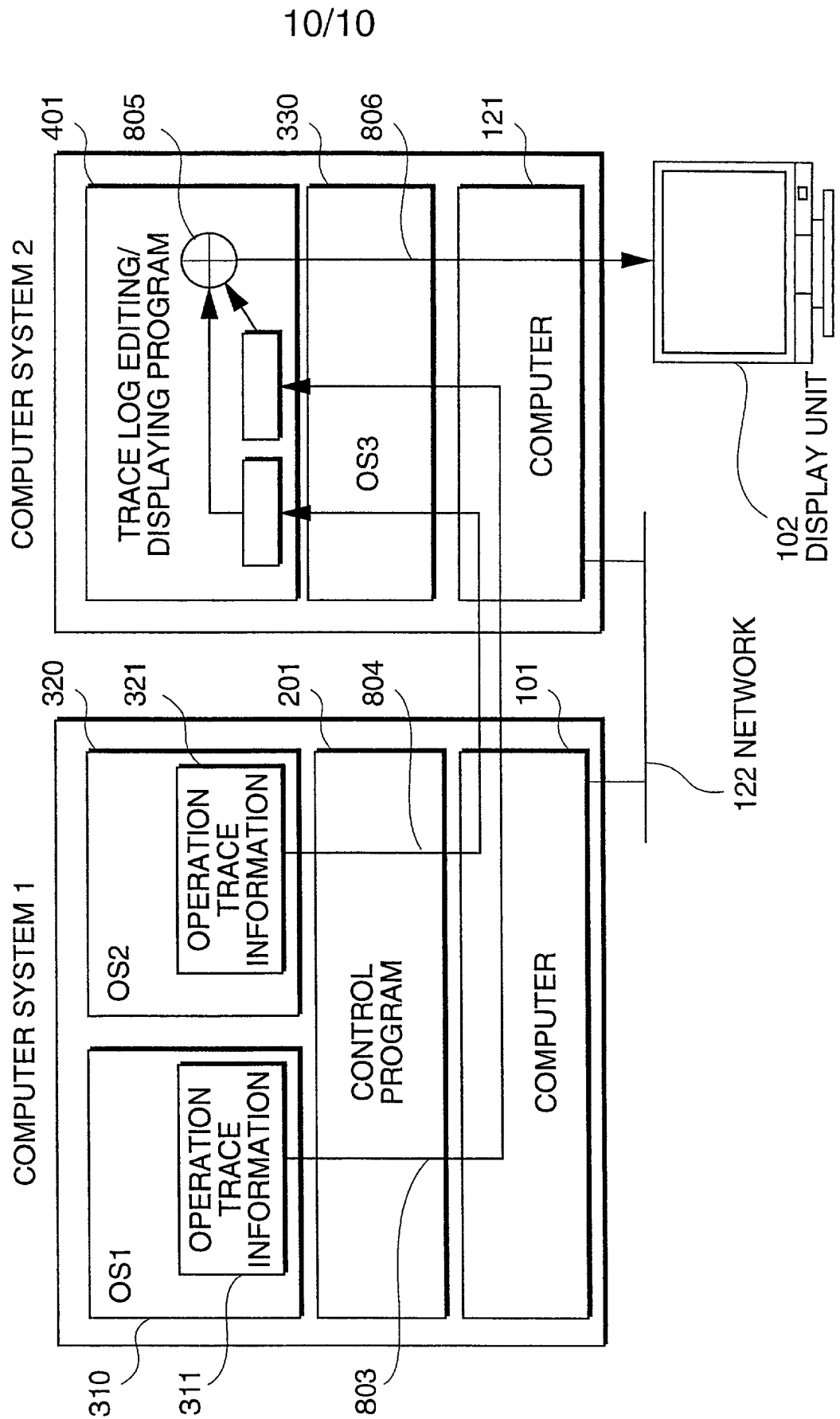


FIG. 10



Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

SYSTEM AND METHOD FOR MANAGING

OPERATING SYSTEMS

上記発明の明細書（下記の欄で×印がついていない場合は、本書に添付）は、

The specification of which is attached hereto unless the following box is checked:

☐ __月__日に提出され、米国出願番号または特許協定条約国際出願番号を____とし、
(該当する場合) _____に訂正されました。

☒ was filed on September 10, 1999
as United States Application Number or
PCT International Application Number
PCT/JP99/04936 and was amended on
_____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration (日本語宣言書)

私は、米国法典第35編119条(a)-(d)項又は365条(b)項に基づき下記の、米国以外の国の少なくとも一カ国を指定している特許協力条約365(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示している。

Prior Foreign Application(s)

外国での先行出願

(Number) (番号)	(Country) (国名)

私は、第35編米国法典119条(e)項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条(c)に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

(Application No.) (出願番号)	(Filing Date) (出願日)

(Application No.) (出願番号)	(Filing Date) (出願日)

私は、私自身の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じていることに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行えば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed

優先権主張なし

(Day/Month/Year Filed) (出願年月日)

(Day/Month/Year Filed) (出願年月日)

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of application.

(Status: Patented, Pending, Abandoned) (現況: 特許許可済、係属中、放棄済)

(Status: Patented, Pending, Abandoned) (現況: 特許許可済、係属中、放棄済)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Japanese Language Declaration (日本語宣言書)

委任状： 私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。(弁護士、または代理人の氏名及び登録番号を明記のこと)

2

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number)

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国籍	Citizenship		
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(Supply similar information and signature for tenth and subsequent joint inventors.)